IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re application of: Sharon LIU et al.	Group Art Unit: 2128
Serial No.: 10/696,081	Examiner: D. Silver
Filed: October 29, 2003	Confirmation No.: 5946

For: ADJOINT-BASED GRADIENT DRIVEN METHOD FOR IDENTIFYING UNKOWN PARAMETERS OF NON-LINEAR SYSTEM MODELS

Docket No.: GP-302997

APPEAL BRIEF PURSUANT TO 37 C.F.R. § 41.37

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Appellant hereby submits its Appeal Brief in response to the final rejection of the subject patent application.

The Commissioner is hereby authorized to charge Ingrassia, Fisher & Lorenz, Deposit Account No. 50-2091, $500 for the filing of this Appeal Brief.

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I. Introduction

This is an Appeal Brief under 37 C.F.R. § 41.37 appealing the rejections set forth in the final Office action dated January 26, 2007. Each of the topics required by 37 C.F.R. § 41.37 is presented in this Brief and is labeled appropriately.

II. Real Party in Interest

General Motors Corporation ("General Motors") is the real party in interest of the present application. An assignment of all rights in the present application to General Motors was executed by the inventors and recorded by the U.S. Patent and Trademark Office at **Reel 014345, Frame 0491**.

III. Related Appeals and Interferences

There are no appeals or interferences related to the present application of which Appellant is aware.

IV. Status of Claims

Claims 22-27 and 29, which are presented in the Claims Appendix, are pending in the application. Each of Claims 22-27 and 29 stands finally rejected, each of as-filed Claims 1-21 and 28 have been canceled. Accordingly, the Appellant hereby appeals the final rejection of Claims 22-27 and 29.

V. Status of Amendments

Following a final Office action, dated January 26, 2007, Appellant filed a Notice of Appeal and a Pre-Appeal Request for Review. In response to the request, a Notice of Panel Decision from Pre-Appeal Brief Review was issued on May 8, 2007, indicating that it was the decision of the Pre-Appeal Brief Panel that the 35 U.S.C. § 102 rejection of Claim 22 delineated in the final Office action was withdrawn, but that the 35 U.S.C. § 103 rejections remain and that the appeal should proceed to the Board of Patent Appeals and Interferences for these rejections.

VI. Summary of Claimed Subject Matter

The sole independent claim on appeal relates to a method of identifying unknown model parameters of a non-linear dynamic system model of an automobile powertrain system having one or more system inputs. The method includes determining a governing state equation for the powertrain system from the powertrain system model (pg. 4, ll. 4-13; pg. 9, l. 1 through pg. 11, l. 4). A cost function is determined based at least in part on one or more powertrain system performance objectives (pg. 4, l. 20-25; FIG. 1). A perturbation state equation is determined from the governing state equation for the powertrain system (pg. 5, ll. 7-25). An adjoint equation is determined from the governing state equation for the powertrain system (pg. 5, ll. 11-15). An adjoint identity is determined from the governing state equation for the powertrain system (pg. 5, ll. 1-11). A perturbation cost function is determined based at least in part on the determined adjoint equation, the determined perturbation state equation, and the determined adjoint identity (pg. 5, ll. 17-23). A gradient is determined based at least in part on the determined adjoint equation (pg. 7, ll. 2-8). The governing state equation, the adjoint equation, and the perturbation cost function are supplied to a general purpose processor (pg. 3, ll. 27-30). The general purpose processor is caused to iteratively determine changes in the perturbation cost function that result from incremental changes in arbitrarily chosen values of one or more of the unknown powertrain system model parameters to thereby identify the unknown powertrain system model parameters (pg. 6, l. 25 through pg. 7, l. 8).

VII. Grounds of Rejection to be Reviewed on Appeal

The grounds of rejection to be reviewed in this appeal are as follows:

1. Whether Claims 22-27 and 29 are unpatentable under 35 U.S.C. § 103 over a publication entitled "Adjoint and Raccati: Essential tools in the analysis and control of transitional and turbulent flow systems," authored by Thomas R. Bewley et al. (hereinafter Bewley et al.) and a publication entitled "Evaluation of Turbocharger Power Assist System Using Optimal Control Techniques," authored by Ilya Kolmanovsky and Anna G. Stefanopoulou (hereinafter Kolmanovsky et al.).

VIII. Arguments

I. CLAIMS 22-27 AND 29 ARE NOT UNPATENTABLE UNDER 35 U.S.C. § 103 OVER BEWLEY ET AL. AND KOLMANOVSKY ET AL.

A. Bewely et al.

Bewley et al. discloses multiple-input-multiple-output (MIMO) nonlinear control input, output estimation, and output prediction using an adjoint gradient algorithm that is quick & efficient for computational fluid dynamics (CFD). More specifically, Bewley et al. are concerned only with control input and output estimation, or output signal prediction, given one initial condition.

B. Kolmanovsky et al.

Kolmanovsky et al. relates to a method for finding an optimal control input trajectory for a setpoint performance target in minimum time for a turbo diesel engine. The input trajectory is described mathematically as a set of linear B-splines. However, because the control input trajectory is unknown, the coefficients of the equation are also unknown. Various tools, such as Mathworks features SQP, explicit gradient computations, and "constr.m" are used to find the co-efficients of the scalar linear splines equation computationally, such that the equation describes ONE scalar time varying engine power input trajectory needed to achieve ONE constant target performance setpoint engine speed, in minimum time, using minimum energy for a deterministic model of a turbo diesel engine.

C. Analysis

The Examiner bears the initial burden of establishing a *prima facie* case of obviousness. In re Fine, 837 F.2d 1071, 1074 (Fed. Cir. 1988). Indeed, the Examiner has the burden of setting forth a detailed evidentiary basis for the teaching, suggestion or motivation to combine the cited references. As the Court of Appeals for the Federal

Circuit has repeatedly stated, the factual inquiry of whether to combine references must be thorough and searching, and must be based upon the objective evidence of record. In re Sang Su Lee, 277 F.3d 1338, 1343 (Fed. Cir. 2002). A claim cannot be found *prima facie* obvious unless all the elements of the claim are taught or suggested in the cited art, the knowledge of one of ordinary skill in the art, or the nature of the problem itself. In re Dembiczak, 175 F.3d 994, 999 (Fed. Cir. 1999); In re Wilson, 424 F.2d 1382, 1385 (C.C.P.A. 1970) ("All words in a claim must be considered in judging the patentability of that claim against the prior art.").

As the Supreme Court recently reiterated, it is "important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does." KSR International Co. v. Teleflex Inc. et al., No. 04-1350 (April 30, 2007) at 15. This, among other reasons, is why prior art references must be considered in their entirety, i.e., as a whole, including portions that would lead away from the claimed invention. W.L. Gore & Associates, Inc. v. Garlock, Inc., 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983), cert. denied, 469 U.S. 851 (1984). Moreover, it is well-settled that, in order to avoid succumbing to the temptation of reliance on hindsight, the teaching or suggestion to make the claimed combination must not be found in an applicant's disclosure. In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). Although it is recognized that any determination of obviousness is, in a sense, based on hindsight reasoning, if the determination does not take into account only knowledge within the level of ordinary skill in the art at the time the claimed invention was made, but relies on knowledge gleaned only from an applicant's own disclosure, then hindsight has been impermissibly applied. In re McLaughlin, 443 F.2d 1392, 1395, 170 USPQ 209, 212 (CCPA 1971).

Appellant submits that the Examiner has not met his burden in establishing a *prima facie* case of obviousness, because the prior art does not objectively teach or suggest all of the claim elements, and as such the Examiner unwittingly relied on impermissible hindsight reasoning.

In particular, the final Office action cites various slides in Bewley et al. as allegedly disclosing the claimed method, with the exception of applying the method to a powertrain model, which is why Kolmanovsky et al. was cited. Nonetheless, when the

final Office action is reviewed, it is clear that the analysis included therein is faulty. For example, the final Office action cites slides 18, 5, 10, and 26 of Bewley et al. as allegedly disclosing the step of determining a perturbation cost function based at least in part on the determined adjoint equation, the determined perturbation state equation, and the determined adjoint identity (final Office action at page 5). Yet, when these slides are objectively reviewed and studied, it is seen that these slides disclose: (1) the adjoint identity (slide 18); (2) a state equation, a perturbation equation, and a cost function (slide 5); (3) how a control solution can be found from a defined state equation and a perturbation equation (slide 10); and (4) implementation of Fourier-space compensators (slide 26). Appellant submits that all of the slides from Bewley et al., let alone those slides identified in the final Office action, can be placed side-by-side and will never, without the aid of Appellant's own disclosure, disclose or even remotely suggest at least this step.

As to Kolmanovsky et al., it was noted above that this reference was cited in the § 103 rejection for its alleged disclosure of "an analogous adjoint-based system modeling" for a powertrain. Appellant submits, however, that close review and study of Kolmanovsky et al. reveals that this article also fails to disclose, or even remotely suggest, at least the above-noted deficiency of Bewley et al. Namely, Kolmanovsky et al. fails to disclose at least determining a perturbation cost function based at least in part on the determined adjoint equation, the determined perturbation state equation, and the determined adjoint identity.

Because Bewley et al. and Kolmanovsky et al., both alone and in combination, fail to disclose or even remotely suggest determining a perturbation cost function based at least in part on the determined adjoint equation, the determined perturbation state equation, and the determined adjoint identity, it thus follows that these references also fail to disclose or suggest: (1) determining a gradient is based at least in part on the determined adjoint equation; governing state equation; (2) supplying the adjoint equation, and the perturbation cost function to a general purpose processor; and (3) causing the general purpose processor to iteratively determine changes in the perturbation cost function that result from incremental changes in arbitrarily chosen values of one or more

of the unknown powertrain system model parameters to thereby identify the unknown powertrain system model parameters.

In view of the foregoing, Appellant submits that the combination of Bewley et al. and Kolmanovsky et al. fails to establish a *prima facie* case of obviousness of independent Claim 22. As such, Appellant submits that independent Claim 22 is not obvious over Bewley et al. and Kolmanovsky et al. Moreover, because independent Claim 22 is nonobvious, then dependent Claims 23-27 and 29 are also nonobvious. In re Fine, supra.

IX. CONCLUSION OF ARGUMENTS

In view of the foregoing, Appellant submits that the rejection of Claims 22-27 and 29 is improper and should not be sustained. Therefore, a reversal of the § 103 rejection in the final Office action dated January 26, 2007 is respectfully requested.

Respectfully submitted,

Dated June 18, 2007

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X. CLAIMS APPENDIX

Claims on Appeal

22. A method of identifying unknown model parameters of a non-linear dynamic system model of an automobile powertrain system having one or more system inputs, the method comprising:

determining a governing state equation for the powertrain system from the powertrain system model;

determining a cost function based at least in part on one or more powertrain system performance objectives;

determining a perturbation state equation from the governing state equation for the powertrain system;

determining an adjoint equation from the governing state equation for the powertrain system;

determining an adjoint identity from the governing state equation for the powertrain system;

determining a perturbation cost function based at least in part on the determined adjoint equation, the determined perturbation state equation, and the determined adjoint identity;

determining a gradient based at least in part on the determined adjoint equation;

supplying the governing state equation, the adjoint equation, and the perturbation cost function to a general purpose processor; and

causing the general purpose processor to iteratively determine changes in the perturbation cost function that result from incremental changes in arbitrarily chosen

values of one or more of the unknown powertrain system model parameters to thereby identify the unknown powertrain system model parameters.

23. The method of Claim 22, further comprising:

determining one or more initial states for solving the governing state equation;

supplying one or more of the initial states to the general purpose processor; and

causing the general purpose processor to iteratively determine changes in the perturbation cost function that result from incremental changes in one or more of the initial states.

24. The method of Claim 22, wherein:

the adjoint equation includes one or more adjoint states; and

the incremental changes are driven by gradients derived from the adjoint states.

25. The method of Claim 22, wherein the changes in the cost function are iteratively determined until a specified accuracy criterion is met.

26. The method of Claim 22, wherein the changes in the cost function are iteratively determined until a predetermined number of iterations is completed.

27. The method of Claim 22, further comprising:

determining the state equation, cost function, adjoint equation, and gradient by supplying one or more exogenous inputs from powertrain system measurements or controller generated signals.

29. The method of Claim 22, further comprising:

validating the non-linear dynamic model using the identified unknown powertrain system model parameters against one or more sets of data.

XI. EVIDENCE APPENDIX

No evidence pursuant to 37 C.F.R. §§ 1.130, 1.131, or 1.132 has been entered by the Examiner or relied upon by Appellant in the instant appeal beyond that which is already contained in the as-filed application, as is delineated in the Arguments section of this Brief.

XII. RELATED PROCEEDINGS APPENDIX

As there are no related appeals and interferences, there are also no decisions rendered by a court or the Board of Patent Appeals and Interferences that are related to the instant appeal.